REMARKS

The remainder of this amendment is set forth under appropriate subheadings for the convenience of the Examiner.

Claim Amendments

Claim 36 has been amended to substitute the limitation that the hydrogen permeable material disposed on the first porous layer and in contact with the first porous layer is not necessarily the hydrogen permeable material of the first porous layer. Support for this limitation is based on the doctrine of claim differentiation in that Claim 38, which is dependent from Claim 36, specifies that the hydrogen permeable material of the first porous layer and of the solid layer are the same material. Further support for amending independent Claim 36 to embrace embodiments wherein the hydrogen permeable material of the first porous layer and of the solid layer are different can be found in the specification at page 10, lines 11-20.

Dependent Claim 39 and independent Claim 56 have been amended to state that the porous base layer is not comprised of a hydrogen permeable material that is selectively permeable to hydrogen gas, thereby clarifying the meaning of Claims 39 and 56, whereby the phrase "hydrogen permeable material" comports with the specification at, for example, page 7, lines 19-29, because a hydrogen permeable material is an embodiment of a "gas-selective material," defined in the specification as "materials which, when formed into dense gas-selective membranes, allow the passage of a select gas, or select gases, through the dense gas-selective membrane."

Independent Claims 47 and 51 have been amended to specify that the hydrogen permeable structure of the respective claimed methods have a porous layer of hydrogen permeable material, wherein the hydrogen permeable material is selectively permeable to hydrogen gas and is in contact with a solid layer of a hydrogen permeable material. Support for the amendments to these claims can be found in the specification at, for example, page 11, line 11 through page 12, line 2, page 15, lines 20-24, and page 16, lines 17-26.

No new matter has been added.

Applicants' Invention

Applicants' claimed composite gas separation module includes, in one embodiment, a porous metal substrate, an intermediate porous metal layer, wherein the intermediate porous metal layer overlies the porous metal substrate, and a dense hydrogen-selective membrane, wherein the dense hydrogen-selective membrane overlies the intermediate porous metal layer. Embodiments of the claimed invention also include a method of fabricating the gas separation module and a method of use of the module for selectively separating hydrogen gas from a hydrogen gas-containing gaseous stream.

In another embodiment, the claimed invention is directed to a hydrogen gas separator, comprising a first porous layer made from a hydrogen permeable material, and a solid layer of a hydrogen permeable material disposed on the first porous layer and in contact with the first porous layer. Other embodiments of the invention are directed to a method of making such a gas separator and a method of purifying hydrogen gas using the claimed gas separator.

Advantages of Applicants' Claimed Invention

As described at, for example, page 2, line 26 through page 3, line 2, one attempted solution to intermetallic diffusion between components of a porous stainless steel substrate and a hydrogen permeable membrane, such as a palladium membrane, has been use of a ceramic substrate, which tends to exhibit less diffusion of substrate components into a hydrogen-selective metal membrane. However, ceramic substrates typically are more brittle than predominantly metal substrates. Further, ceramic substrates can be more difficult to fabricate and can also be more difficult to join to other components in a gas separation system.

Applicants' claimed apparatus includes an intermediate porous metal layer that can protect against intermetallic diffusion between a porous metal substrate and a dense gas-selective membrane. As described at page 11, line 11 through page 12, line 2, and without being held to any particular theory, it is believed that any intermetallic diffusion between the intermediate porous metal layer and the dense gas-selective membrane is thought not to be harmful to the gas selectivity of the membrane. Further, as described at page 12, lines 3 - 13, the intermediate porous metal layer of the claimed invention can improve adhesion of the dense gas-selective membrane to the porous metal substrate, thereby substantially avoiding membrane blistering,

delamination and/or cracking, even when operating at high temperatures and/or for extended periods of time. As further stated in the specification, and without being held to any particular theory, it is believed that the improvement in adhesion results from interdiffusion of metal particles of the intermediate porous metal layer and/or intermetallic diffusion between the intermediate porous metal layer and the porous metal substrate on one side and the dense gas-selective membrane on the other side.

Objection to the Specification

The Examiner objected to the disclosure, requesting that incomplete sections at lines 26 and 28 of page 25 be corrected.

Applicants have amended the specification as requested by the Examiner. No new matter has been added.

Objections to the Claims

The Examiner objected to Claim 38 as being of improper dependent form in that Claim 38 recites that materials used in different layers are the same, whereas independent Claims 36, from which Claim 38 depends, includes the same limitation.

As discussed above, Claim 36 has been amended to substitute the word "said" with the antecedent "a" to embrace the option of including different hydrogen permeable materials in the first porous layer and in the solid layer of the claimed hydrogen gas separator. Therefore, Claim 38, further limits the scope of dependent Claim 36 by specifying that the hydrogen permeable material of the first porous layer and of the solid layer are the same material. Applicants' amendment of Claim 36 obviates the Examiner's objection to Claim 38.

Rejection of Claims Under 35 U.S.C. § 112, Second Paragraph

Claims 39 and 41 are rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim subject matter which Applicants regard as the invention. In particular, the Examiner stated that Claim 39 recites that the porous base layer is not comprised of a hydrogen permeable material, but that the base layer must be hydrogen permeable for the claimed hydrogen separator to operate. The Examiner

suggested that clarification of the term "permeable" would overcome this objection. Claim 41 was rejected as depending from a rejected base claim.

As discussed above, Claim 39 has been amended to specify that the hydrogen permeable material is selectively permeable to hydrogen gas. As stated at page 6, line 25 through page 7, line 2, a "gas-selective material," such as a "hydrogen-selective membrane," is defined as "a material that is selectively permeable to a gas, and that is not materially breached by regions or points which impair the separation of the gas by allowing the passage of an undesired gas." As amended, Claim 39 is internally consistent in that a base layer that is porous, and, therefore, has a layer permeable by all gases, is constructed of a material that is not, itself, selectively permeable to hydrogen gas. Therefore, Claim 39, as amended, and Claim 41, which depends from Claim 39, meet the requirements of 35 U.S.C. § 112, second paragraph, in view of the Examiner's basis for rejection.

Rejection of Claims Under 35 U.S.C. § 112, First Paragraph

Claims 40, 42-44, 52 and 53 are rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement. In particular, the Examiner stated that the rejected claims contained subject matter which is not described in the specification in such a way as to reasonably to convey to one skilled in the relevant art that the inventor, at the time the application was filed, had possession of the claimed invention because, according to the Examiner, the specification does not disclose any of the limitations of the listed claims.

Support for previously presented Claim 40 can be found at page 11, lines 7-10, which states that "the intermediate porous metal layer can have a mean pore size that is less than the mean pore size of the porous metal substrate. In one embodiment, the largest pore of the intermediate porous metal layer is smaller than the largest pore of the porous metal substrate."

Support for previously presented Claim 42 can be found at page 6, line 25 through page 7, line 5, which states the following:

> The composite gas separation modules described herein include a dense gas-selective membrane such as, for example, a dense hydrogen-selective membrane. The dense hydrogen-selective membrane can include, for example, palladium or an alloy thereof. A "dense gas-selective membrane," as that term is used herein,

> refers to a component of a composite gas separation module that has one or more layers of a gas-selective material, *i.e.*, a material that is selectively permeable to a gas, and that is not materially breached by regions or points which impair the separation of the gas by allowing the passage of an undesired gas. For instance, in one embodiment, the dense gas-selective membrane is not materially breached by regions or points which do not have the desired gas selectivity properties of the gas-selective material.

Support for previously presented Claim 43 can be found at page 9, lines 4-5 which state:

> In one embodiment, porous metal substrate 12 also includes a layer of ceramic bonded thereto.

Additional support can be found at page 12, lines 14-18 which state:

> The composite gas separation module can further include a substrate surface treatment underlying the intermediate porous metal layer, as described *infra*. For example, a layer of a ceramic can be bonded to the porous metal substrate and underlie the intermediate porous metal layer. The ceramic can include oxides, nitrides, and/or carbides, for example, iron oxide, iron nitride, iron carbide and/or aluminum oxide.

Further support for previously presented Claim 43 can be found at Claims 1 and 2 of U.S. Provisional Patent Application No.: 60/457,061, which is incorporated by reference in the present application.

Support for previously presented Claim 44 can be found at page 10, lines 24-29, which state:

> In one embodiment, the intermediate porous metal layer contains about three to about six layers of palladium that alternate with about 2 to about 4 layers of the Group IB metal. The thickness of the individual alternating layers can be about 0.05 to about 5 microns thick, *e.g.*, about 0.1 to about 4 microns, about 0.2 to about 3 microns, or about 0.3 to about 1.5 microns. Examples of the order of the deposited layers include, but are not limited to, Pd-Ag-Pd-Ag-Pd and Pd-Ag-Pd-Ag-Pd-Pd-Ag-Pd-Ag-Pd.

Further support can be found at page 12, lines 19-20, which state:

> The composite gas separation module can also further comprise a layer of a metal selected from the group consisting of palladium, gold and platinum, wherein the layer of metal overlies the porous metal substrate and/or a substrate surface treatment and underlies the intermediate porous metal layer. Such deposits of metal are discussed *infra*.

Support for previously presented Claim 52 can be found at page 16, lines 4-6, which state:

> Components of the dense gas-selective membrane, *e.g.*, a hydrogen-selective metal or an alloy thereof, can be deposited over the intermediate porous metal layer using any of the techniques known in the art for depositing such materials on a support.

Additional support can be found at page 24, lines 7-11:

> In another embodiment, a first component of the dense gas-selective membrane can be applied over the intermediate porous metal layer, the deposited first component can be abraded, and a second component of the dense gas-selective membrane can be applied over the abraded, deposited first component.

Support for previously presented Claim 53 can be found at page 6, line 25 through page 7, line 5, which state:

> The composite gas separation modules described herein include a dense gas-selective membrane such as, for example, a dense hydrogen-selective membrane. The dense hydrogen-selective membrane can include, for example, palladium or an alloy thereof. A "dense gas-selective membrane," as that term is used herein, refers to a component of a composite gas separation module that has one or more layers of a gas-selective material, *i.e.*, a material that is selectively permeable to a gas, and that is not materially breached by regions or points which impair the separation of the gas by allowing the passage of an undesired gas. For instance, in one embodiment, the dense gas-selective

> membrane is not materially breached by regions or points which do not have the desired gas selectivity properties of the gas-selective material.

Therefore, all of the claims rejected under 35 U.S.C. § 112, first paragraph are supported by the specification as originally filed.

Rejection of Claims Under the Judicially-Created Doctrine of Obviousness-Type Double Patenting

Claims 1-8, 12, 13 and 36-39 are provisionally rejected under the judicially-created doctrine of obviousness-type double patenting as being unpatentable over Claims 27 and 31-39 of co-pending application number 10/804,847.

Upon satisfactory resolution of the other rejections and objections, Applicants will file a terminal disclaimer to overcome this provisional rejection in the event that it has not been otherwise obviated.

Rejection of Claims Under 35 U.S.C. § 102(b) as Being Anticipated by 5,498,278, by Edlund

Claims 47, 48, 50 and 51 are rejected under 35 U.S.C. § 102(b) as being anticipated by Edlund '278. In particular, the Examiner stated that Edlund '278 teaches a method of purifying hydrogen, comprising selectively permeating hydrogen across a composite membrane, wherein the membrane includes a tube-shaped porous metal that can be palladium, a metal oxide intermediate layer overlying the support, and a palladium or palladium alloy membrane layer that is deposited on the intermediate layer. The Examiner references Col. 7, line 23 to Col. 9, line 15 of Edlund '278 for support.

Independent Claim 47 is directed to a method of purifying hydrogen gas. The method, as set forth in amended Claim 47, includes providing a hydrogen permeable structure having a porous layer of hydrogen permeable material, wherein the hydrogen material is selectively permeable to hydrogen gas and is in contact with a solid layer of hydrogen permeable material. The hydrogen permeable structure is exposed to a gas containing hydrogen gas and a pressure differential is caused to cross the hydrogen permeable structure, wherein the hydrogen gas

permeates through the hydrogen permeable structure and is collected. Support for the amendment to Claim 47, whereby the phrase "covered by" is replaced by the requirement that the hydrogen permeable material is selectively permeable to hydrogen gas and is in contact with a solid layer of hydrogen permeable material, is supported in the specification at, for example, page 11, line 11 through page 12, line 2, which describes intermetallic diffusion between the intermediate porous metal layer and the overlying dense gas-selected membrane on the intermediate porous metal layer. Further support can be found at page 15, lines 20-24 which states:

> In one embodiment, the present invention can include the step of depositing a hydrogen-selective metal on the intermediate porous metal layer, thereby forming a coated substrate and abrading the surface of the coated substrate, thereby forming a polished substrate, prior to formation of the dense gas-selective membrane (*e.g.*, a dense hydrogen-selective membrane) over the intermediate porous metal layer.
>
> Following application of the intermediate porous metal layer, a dense gas-selective membrane is applied over the intermediate porous metal layer.

Still further support can be found at page 16, lines 7-10 which state:

> For example, a component of the dense gas-selective membrane can be deposited on the support using electroless plating, thermal deposition, chemical vapor deposition, electroplating, spray deposition, sputter coating, e-beam evaporation, ion beam evaporation or spray pyrolysis.

Edlund '278 teaches a multicomponent composite metal membrane that includes a flexible porous intermediate layer between a support layer and a non-porous hydrogen-permeable coating metal layer. As stated at Col. 8, lines 29-32, the intermediate layer "forms a continuous layer between the support matrix and the coating metal, and further serves to prevent contact between the base metal and the coating metal." Further, as stated by Edlund '278, at Col. 8, lines 33-35, the intermediate layer is "porous or microporous, which allows hydrogen to flow

between both parallel and perpendicular to and through the plane of the layer relatively unimpeded." The composition of the intermediate layer is described in Col. 8, line 64 through Col. 9, line 14. As stated, for example, at Col. 8, line 64, though Col. 9, line 8:

> The chemical composition of the intermediate layer may be described as ceramic and glass fibers; the oxides of aluminum, silicon, boron, calcium, magnesium, and mixtures thereof; nitrides and carbides of boron; nitrides, carbides, and borides of silicon and aluminum; oxides, sulfides, carbides, borides, and nitrides of all of the Lanthanide metals, scandium, yttrium, molybdenum, tungsten, and all of the Group IVB and VB metals; silicides of all of the Group IVB and VB metals, and of scandium, yttrium, and all of the Lanthanide metals; zeolites; carbon; and chemically and thermally stable mixtures containing $\geqq$ 50% of such materials, compounds, and complexes.

There is no disclosure or suggestion anywhere in Edlund '278 of providing a hydrogen permeable structure having a porous layer of hydrogen permeable material in contact with a solid layer of hydrogen permeable material, as set forth in amended Claim 47. More specifically, there is no disclosure or suggestion of employing a porous layer formed of a hydrogen permeable material whereby, as described above, and defined by Applicants, the hydrogen permeable material is selectively permeable to hydrogen gas. Therefore, there is no disclosure or suggestion of a solid layer of a hydrogen permeable material in contact with a porous layer of hydrogen permeable material, whereby, as set forth in Applicants' amended Claim 47, the resulting hydrogen permeable structure is exposed to a gas containing hydrogen and a pressure differential across the hydrogen permeable structure is created, and wherein the hydrogen gas permeates through the hydrogen permeable structure and is collected. Therefore, Claims 48 and 50, which depend from independent Claim 47, also are novel in view of Edlund '278.

Similarly, independent Claim 51, as amended, includes forming a first porous layer from a hydrogen permeable material, wherein the hydrogen permeable material is selectively permeable to hydrogen gas, and then depositing a solid layer of the hydrogen permeable material in contact with the porous layer.

There is no disclosure or suggestion in Edlund '278 of depositing a solid layer of hydrogen permeable material, in contact with a porous layer of a hydrogen permeable material,

wherein the hydrogen permeable material is selectively permeable to hydrogen gas. Therefore, the subject matter of Claim 51 also is novel in view of the teachings of Edlund '278.

Rejection of Claims Under 35 U.S.C. § 102(b) as Being Anticipated by U.S. 5,738,708, by Peachey *et al.*

Claims 1, 12, 13, 15, 25-29, 35, 47, 49, 50 and 56 are rejected under 35 U.S.C. § 102(b) as being anticipated by Peachey *et al.* '708. In particular, the Examiner stated that Peachey et al. '708 teach a composite metal membrane for selectively permeating hydrogen from a gas mixture, comprising a porous metal substrate, an intermediate metal oxide or metal sulfide layer deposited on the substrate, and a palladium or palladium/Ag alloy hydrogen permeable layers deposited on the intermediate layer on each side of the substrate. The Examiner referenced Col. 2, line 58 through Col. 4 line 12, of Peachey *et al.* '708 for support.

Each of independent Claims 1, 15 and 29 each include an intermediate porous metal layer between a porous metal substrate and a hydrogen selective membrane. Claims 12, 13, 25 – 28, and 35 all depend, directly or indirectly, from one of independent Claims 1, 15 and 29. Independent Claims 47 and 56 both require a porous layer of a hydrogen permeable material, wherein the hydrogen permeable material is selectively permeable to hydrogen gas, and contact between the porous layer of hydrogen permeable material with a solid layer of a hydrogen permeable material. Claims 49 and 50 depend from independent Claim 47.

As described by the Examiner, Peachey *et al.* '708 teaches the presence of an intermediate metal oxide or metal sulfide layer deposited on a substrate, and a palladium or a palladium/silver alloy hydrogen permeable layer deposited on the intermediate metal oxide or metal sulfide layer.

There is no disclosure or suggestion by Peachey *et al.* '708 of an intermediate porous metal layer, wherein the intermediate porous metal layer overlies a porous metal substrate, and a dense hydrogen selective membrane, wherein the dense hydrogen selective membrane overlies the intermediate porous metal layer, as set forth in Applicants' independent Claim 1. There also is no disclosure or suggestion in Peachey *et al.* '708 of Applicants' claimed method for fabricating the composite gas separation module, including the steps of applying an intermediate porous metal layer over a porous metal substrate, and applying a dense hydrogen selective

membrane over the intermediate porous metal layer, thereby forming the composite gas separation module. Peachey *et al.* '708 also does not disclose or suggest Applicants' method of Claim 29, including directing a hydrogen gas-containing gaseous stream to a composite gas separation module, wherein the gas separation module includes a porous metal substrate, an intermediate porous metal layer wherein the intermediate porous metal layer overlies the porous metal substrate, and a dense hydrogen-selective membrane wherein the dense hydrogen-selective membrane overlies the intermediate porous metal layer. There also is no disclosure or suggestion in Peachey *et al.* '708 of Applicants' method of purifying hydrogen gas as set forth in amended Claim 47, wherein the hydrogen permeable structure has a porous layer of a hydrogen permeable material, the hydrogen permeable material being selectively permeable to hydrogen and in contact with a solid layer of a hydrogen permeable material, by exposing the hydrogen permeable structure to a gas containing hydrogen gas. With respect to Applicants' independent Claim 56, there is no disclosure or suggestion in Peachey *et al.* '708 of a hydrogen gas separator that includes a first porous layer made from a first hydrogen permeable material, the first hydrogen permeable material being selectively permeable to a hydrogen gas, and a solid layer of a second hydrogen permeable material disposed on said first porous and in contact with the first porous layer. Therefore, none of the claims identified by the Examiner are anticipated by the teachings of Peachey *et al.* '708 under 35 U.S.C. § 102(b).

Rejection of Claims Under 35 U.S.C. § 102(b) as Being Anticipated by U.S. 6,183,542, by Bossard

Claims 36-39, 41, 47, 49-52 and 54-57 are rejected under U.S.C. § 102(b) as being anticipated by U.S. 6,183,542, issued to Bossard. In particular, the Examiner stated that Bossard '542 teaches a membrane for selectively permeating hydrogen from a gas mixture, comprising the palladium or palladium alloy membrane layer (30) that is sandwiched between two porous mesh layers (32, 34) that can be stainless steel using brazing with a layer of brazing powder. Multiple layers of mesh having differing sizes can be added to each side of the membrane (Col. 5, line 1 to Col. 6, line 13). The Examiner further stated that the mesh and membrane layers are contoured, and made reference to FIGS. 2 and 3 of Bossard '542.

There is no disclosure or suggestion in Bossard '542 that a porous component of the apparatus, specifically mesh layers (32, 34), can be formed of a hydrogen permeable material that is permeable to hydrogen gas, as is required of the porous layer of independent Claims 36, 47, 51, 56 and 57, rejected under 35 U.S.C. § 102(b) by the Examiner as being anticipated by Bossard '542. Therefore, none of these independent claims, nor the claims identified by the Examiner which are dependent from them, are anticipated by the teachings of Bossard '542.

Rejection of Claims Under 35 U.S.C. § 102(b) as Being Anticipated by U.S. 2002/0020298, by Drost *et al.*

Claims 1, 10-13, 15, 25-29, 35, 47, 49 and 56 are rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. 2002/0020298, by Drost *et al.* In particular, the Examiner stated that Drost et al. '298 teaches a supporting membrane for selectively permeating hydrogen from a gas mixture, comprising a porous or sintered metal support layer (3), an intermediate porous diffusion barrier layer (9) deposited on the support layer, and a palladium or palladium/Ag alloy membrane layer (2) deposited on the intermediate layer using chemical or physical vapor deposition. The Examiner stated that the intermediate layer described by Drost *et al.* '298 has a thickness of less than 2 microns and has a lower porosity than the support layer.

Contrary to the Examiner's statement, there is no disclosure or suggestion anywhere in Drost *et al.* '298 that diffusion inhibiting barrier (9) is porous. Evidence that the diffusion barrier described in Drost *et al.* '298 is not, in fact, porous, but rather continuous, can be found at paragraph 39, which specifies vanadium, tantalum and niobium as suitable metals for fabrication of diffusion barriers because "These metals have a good permeability for hydrogen." Therefore, instead of teaching porous diffusion barriers, Drost *et al.* '298 actually teach away from use of porous diffusion barriers by specifically calling out use of metals that are permeable to hydrogen. Further, FIG. 3 clearly shows that diffusion barrier (9), in contrast to membrane support (3), is not porous.

Each of Applicants' independent Claims 1, 15, 29, 47 and 56 require that the intermediate metal layer be porous. Therefore, Drost *et al.* '298 does not anticipate any of Applicants' independent claims identified by the Examiner, nor any of the referenced claims dependent from them.

Rejection of Claims Under 35 U.S.C. § 102(b) as Being Anticipated by U.S. 6,152,987, by Ma *et al.*

Claims 1-3, 9, 10, 12-16, 25-31, 34, 35, 47-49 and 56 are rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. 6,152,987, issued to Ma *et al.* In particular, the Examiner stated that Ma *et al.* '987 teaches a composite membrane for selectively permeating hydrogen from a reaction product mixture, comprising a tubular porous stainless steel substrate (12), a ceramic or metal oxide intermediate diffusion layer deposited on the substrate, and a palladium or Pd/Ag alloy membrane layer deposited on the intermediate layer using electroplating or other deposition techniques. The Examiner referenced the Figure, Col. 1, lines 30-32, Col. 3, lines 21-54, Col. 4, lines 12-65, Col. 5, line 45 through Col. 6, line 38 and Col. 7, lines 21-60 for support. Further, the Examiner stated that other metals such as Fe, Ni, Ti, Cr, Al and alloys may be used as the substrate material.

Independent Claims 1, 15 and 29 require the presence of an intermediate porous metal layer overlying a porous metal substrate. Applicants' independent Claims 47 and 56 include a porous layer of a hydrogen permeable material, wherein the hydrogen permeable material is selectively permeable to hydrogen gas, and a solid layer of a hydrogen permeable material in contact with the porous layer of hydrogen permeable material.

There is no disclosure or suggestion in Ma *et al.* '987 of an intermediate porous metal layer overlying a porous metal substrate, as is required by Applicants' independent Claims 1, 15 and 29. Further, there is no disclosure or suggestion in Ma *et al.* '987 of a porous layer of a hydrogen permeable material, wherein the hydrogen permeable material is selectively permeable to hydrogen gas, and wherein the porous layer of hydrogen permeable material is in contact with a solid layer of a hydrogen permeable material, as is required by Applicants' independent Claims 47 and 56. The remaining claims identified by the Examiner are each directly or indirectly dependent from one of independent Claims 1, 15, 29, 47 and 56. Therefore, the dependent claims also are not anticipated by the teachings of Ma *et al.* '987.

Rejection of Claim 19 Under 35 U.S.C. § 103(a) as Being Unpatentable over Ma *et al.* '987

Claim 19 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Ma *et al.* '987. Specifically, the Examiner stated that Ma *et al.* '987 discloses all the limitations of the claim except that the intermediate layer is applied by electroless plating, but disclose that any conventional method can be used and that electroplating is used to deposit the membrane layer. The Examiner further stated that one having ordinary skill in the art at the time of the invention would have known to use electroless plating or any other suitable method that would effectively deposit the intermediate layer in a controlled manner and thickness.

Claim 19 is dependent from independent method Claim 15. As discussed above, there is no disclosure or suggestion in Ma *et al.* '987 of a method for fabricating a composite gas separation module, as set forth in Applicants' Claim 15, wherein an intermediate porous metal layer is applied over a porous metal substrate, and a dense hydrogen-selected membrane is applied over the intermediate porous metal layer, to thereby form the composite gas separation module. Independent method Claim 15 meets the requirements of U.S.C. § 103(a) in view of the teachings of Ma *et al.* '987. Since Claim 19 depends from independent Claim 15, Claim 19 also meets the requirements of 35 U.S.C. § 103(a) in view of Ma *et al.* '987.

Allowable Subject Matter

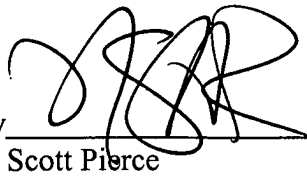
Applicants' acknowledge the Examiner's objection to Claims 17, 18, 20-24, 32, 33, 45, 46 and 53 as being dependent on a rejected base claim, but allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

SUMMARY AND CONCLUSIONS

The incomplete sections of lines 26 and 28 of page 25 in Applicants' specification have been corrected by substitution of the paragraph. The objection to Claim 38 has been obviated by amendment of independent Claim 36 from which Claim 38 depends. Claim 39 has been amended to specifically identify the hydrogen permeable material as being selectively permeable to hydrogen gas, thereby overcoming the rejections of Claim 39 and dependent Claim 41 under 35 U.S.C. § 112, second paragraph as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention. Applicants have provided the Examiner with detailed support from the specification for Claims 40, 42-44, 52 and 53 in response to the rejection of these claims under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement. A terminal disclaimer will be prepared and filed upon resolution of all other objections and rejections of the claims in the event that the provisional obviousness-type double patenting rejection has not been otherwise obviated. As amended, none of the pending claims are anticipated or rendered obvious by any of the references relied upon by the Examiner, either separately or in combination. Therefore, the application is in condition for allowance, and Applicants respectfully request reconsideration and withdrawal of all of the statutory objections and rejections of the pending claims, as amended. If the Examiner believes that a telephone conference would expedite prosecution of this case, he is respectfully requested to contact Applicants' undersigned Attorney.

Respectfully submitted,

HAMILTON, BROOK, SMITH & REYNOLDS, P.C.



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Dated: 1/19/06